

ERIONITE

CAS No. 66733-21-9

First Listed in the *Seventh Annual Report on Carcinogens*

CARCINOGENICITY

Erionite is *known to be a human carcinogen* based on sufficient evidence of carcinogenicity in humans (IARC 1987a,b). Descriptive studies have demonstrated very high mortality from malignant mesothelioma, mainly of the pleura, in three Turkish villages where there was contamination from erionite and where the population had been exposed from birth. Erionite fibers were identified in lung tissue samples in cases of pleural mesothelioma; ferruginous bodies were found in a much higher proportion of inhabitants in contaminated villages than of those in two control villages (Baris 1991).

An IARC Working Group reported that there is sufficient evidence of carcinogenicity of erionite in experimental animals (IARC 1987a,b). When administered by inhalation, erionite induced plural mesotheliomas in rats of both sexes. When administered by intraperitoneal injection, erionite induced peritoneal mesotheliomas in male mice. When administered by intrapleural injection, erionite induced pleural mesotheliomas in male and female rats.

PROPERTIES

Erionite is a naturally occurring fibrous zeolite. Its basic structure is aluminosilicate tetrahedra. The oxygen is shared between two tetrahedra. The structure of erionite is chainlike, with six tetrahedra on each edge of the unit forming part of a chain of indefinite length. Erionite consists of white prismatic crystals in radiating groups. It is not known to occur in other than fibrous form, in single needles, or in clusters. Erionite fibers, with a maximum length of approximately 50 μm , are generally shorter than asbestos fibers. Erionite particles (ground to powder) resemble amphibole asbestos fibers. It absorbs water up to 20% of its weight. Its gas absorption, ion exchange, and catalytic properties are highly selective. Zeolites, in general, have good thermal stability, rehydration kinetics, and water vapor adsorption capacity (Clifton 1985).

USE

Natural zeolites have many commercial uses; these molecules selectively adsorb molecules from water or air. A former use of erionite was as a noble metal-impregnated catalyst in a hydrocarbon-cracking process (IARC 1987a, EPA 1988). A minor and probably unintentional use of erionite is for house building materials of erionite-rich blocks (IARC 1987a). Its use to increase soil fertility and to control odors in livestock production has been studied. Natural erionite has been replaced by synthetic nonfibrous zeolites (EPA 1988). Erionite is not known to be currently mined or marketed for commercial purposes (IARC 1987a).

In 1978, the use of zeolites to solve environmental pollution and energy conservation problems showed promise and was expected to increase (Mumpton 1978). The real and potential uses of natural zeolites rapidly expanded. Zeolites purify sludge effluents to potable standards. They have the ability to extract trace amounts of heavy metals so that existing water supplies may be reused. They extract radioactive species from nuclear plant wastes; the zeolites retain their ion-exchange capacities and are resistant to nuclear degradation. In agricultural uses, zeolites decrease ammonia released from animal wastes and retain the nitrogen in the solid wastes, which

increases the fertilizer value of the solid material. Zeolites may be spread or hung in chicken houses to reduce noxious fumes of ammonia and hydrogen sulfide; egg production is increased when they are used in chicken houses. They may be spread on the floors of pig farms to absorb liquid waste and reduce odors. Additionally, studies have shown them to be good feed supplements to increase the feed conversion value; they also appear to exhibit antibiotic properties that reduce illness and death rates among farm animals. Zeolites have been used to neutralize low pH soils. Zeolites may have applications to control aquaculture environments and fish culture recirculating water systems and have been used to remove sulfur dioxide from coal- and oil-burning power plant emissions; they are especially suited to low pH and high-temperature exhaust gas systems. Natural zeolites can absorb oil spills. They have been used for oxygen production for enclosed, poorly ventilated spaces, for river and pond aeration, to reoxygenate downstream waters of paper and pulp plants, and for secondary sewage treatment. They have use in coal gasification and natural gas purification. The dehydration and rehydration of zeolites results in the exchange of several hundred BTUs per pound; this heat exchange has potential use for solar energy collection. Zeolites have potential miscellaneous uses in paper products, construction products, fluoride toothpaste, and in recycle-dialysis systems.

PRODUCTION

Current commercial production and marketing of erionite is not known (IARC 1987a, CEH 2000). Erionite was first described in 1898, but reports of occurrences were not published until 1959. Commercial mining of zeolites, including ores containing erionite, began in the 1960s. In the 1970s, two U.S. companies mined erionite at two of six mineable deposits in the United States (IARC 1987a). Erionite was one of the four commercially important zeolites in the 1970s (Mumpton 1978, Kirk-Othmer 1981).

Production of all natural zeolites in 1982 and 1983 was estimated to be 10,000 lb (Clifton 1983, 1984). Natural zeolite production for 1984 was estimated to be 5,200 lb and reported to be 26,000 lb in 1985 (Clifton 1985, 1986).

EXPOSURE

Airborne erionite fibers are generally respirable (EPA 1988). Current potential occupational exposure to erionite appears to be as the result of mining and producing other natural zeolites that are of commercial importance. Erionite is reported to be a minor component in some commercial zeolites (Mondale *et al.* 1978). Production and use of other zeolites may result in potential exposure for the workers and the general population who use the zeolites in a variety of processes and products. Natural zeolites, some of which may contain erionite fibers, are used for their ion-exchange properties to remove harmful ions from radioactive waste or ammonia from sewage and agricultural waste (Harben and Bates 1984). They may be used in stack scrubbers in air pollution control systems, as cement aggregates, and for solar energy heat exchange (Rom *et al.* 1983). Zeolites are used in fertilizers and soil amendments, and they are added to animal feed to increase the feed conversion value. Another potential agricultural use of zeolites is to purify water in catfish farming (Clifton 1985). Zeolites are used as carriers for herbicides, fungicides, and pesticides. Potential uses for zeolites are in papermaking, in toothpaste, in plywood glue, as a catalyst, and in oxygen production (Harben and Bates 1984). A possible domestic use of zeolite is in cat litter to control odor (Clifton 1986). Zeolites were once ingredients in laundry detergents (Clifton 1984).

All workers involved in the production or use of zeolite-containing products are potentially exposed to erionite which is mined with deposits of other zeolites. Total dust exposures in an open-pit zeolite (containing erionite) mine in Arizona for miners ranged from 0.1 to 13.7 mg/m³; respirable dust in the mining area was 0.01 to 1.4 mg/m³ (IARC 1987a).

Although actual occupational exposure to erionite is unknown, the nonoccupational exposure has been clearly identified in three villages in central Cappadocia in Central Turkey, where the rate of mesothelioma cases has in some instances been four times greater than that resulting from exposure to asbestos (Esmen and Erdal 1990). Mineralogical analysis of the victims' lung tissues showed more than 90% of the fibrous particles to be erionite (Baris 1991), and erionite-containing volcanic tuffs were found in samples collected from the walls of local dwellings and rock and dust samples (Pooley 1979, cited by Baris *et al.* 1996).

Zeolites are probably the most extensive family of minerals in the earth's crust (Vaughan 1978). Fibrous and nonfibrous zeolites are common minerals in the western United States; 10 trillion tons of reserves and 120 million tons exist near the surface of the ground (Rom *et al.* 1983). The zeolite beds may be up to 15 feet thick and may lie in surface outcroppings. Deposits of fibrous erionite are located in Arizona, Nevada, Oregon, and Utah. Erionite fibers have been detected in samples of road dust in Nevada. U.S. residents of the Intermountain West may be potentially exposed to fibrous erionite in ambient air (Rom *et al.* 1983, IARC 1987a).

REGULATIONS

EPA regulates erionite under the Toxic Substances Control Act (TSCA) as a chemical substance for which there are significant new uses and thereby specifies procedures for manufacturers, importers, or processors to report on those significant new uses.

OSHA regulates erionite under the Hazard Communication Standard and as a chemical hazard in laboratories. Regulations are summarized in Volume II, Table 83.

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